

# PESDxU1UT series

Ultra low capacitance ESD protection diode in SOT23 package

Rev. 01 — 11 May 2005

Product data sheet

## 1. Product profile

### 1.1 General description

Ultra low capacitance ElectroStatic Discharge (ESD) protection diode in a SOT23 (TO-236AB) small SMD plastic package designed to protect one high-speed data line from the damage caused by ESD and other transients.

### 1.2 Features

- Unidirectional ESD protection of one line
- Ultra low diode capacitance:  $C_d = 0.6 \text{ pF}$
- Max. peak pulse power:  $P_{PP}$  up to 200 W
- Low clamping voltage
- ESD protection  $> 23 \text{ kV}$
- IEC 61000-4-2; level 4 (ESD)
- IEC 61000-4-5; (surge)

### 1.3 Applications

- 10/100/1000 Ethernet
- FireWire
- Communication systems
- Local Area Network (LAN) equipment
- Computers and peripherals
- High-speed datalines

### 1.4 Quick reference data

Table 1: Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{RWM}$	reverse stand-off voltage					
	PESD3V3U1UT		-	-	3.3	V
	PESD5V0U1UT		-	-	5.0	V
	PESD12VU1UT		-	-	12	V
	PESD15VU1UT		-	-	15	V
	PESD24VU1UT		-	-	24	V
$C_d$	diode capacitance	$f = 1 \text{ MHz}; V_R = 0 \text{ V}$	[1]	-	0.6	$\text{pF}$

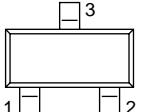
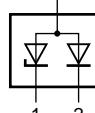
[1] Measured from pin 1 to 2

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## 2. Pinning information

Table 2: Pinning

Pin	Description	Simplified outline	Symbol
1	cathode ESD protection diode		
2	cathode compensation diode		
3	common anode		 006aaa441

## 3. Ordering information

Table 3: Ordering information

Type number	Package			Version
	Name	Description		
PESD3V3U1UT	-	plastic surface mounted package; 3 leads		SOT23
PESD5V0U1UT				
PESD12VU1UT				
PESD15VU1UT				
PESD24VU1UT				

## 4. Marking

Table 4: Marking codes

Type number	Marking code [1]
PESD3V3U1UT	*AP
PESD5V0U1UT	*AQ
PESD12VU1UT	*AR
PESD15VU1UT	*AS
PESD24VU1UT	*AT

[1] \* = -: made in Hong Kong  
 \* = p: made in Hong Kong  
 \* = t: made in Malaysia  
 \* = W: made in China



## 5. Limiting values

**Table 5: Limiting values**

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
P <sub>PP</sub>	peak pulse power	8/20 $\mu$ s	[1]		
	PESD3V3U1UT		-	80	W
	PESD5V0U1UT		-	80	W
	PESD12VU1UT		-	200	W
	PESD15VU1UT		-	200	W
	PESD24VU1UT		-	200	W
I <sub>PP</sub>	peak pulse current	8/20 $\mu$ s	[1]		
	PESD3V3U1UT		-	5	A
	PESD5V0U1UT		-	5	A
	PESD12VU1UT		-	5	A
	PESD15VU1UT		-	5	A
	PESD24VU1UT		-	3	A
T <sub>j</sub>	junction temperature		-	150	°C
T <sub>amb</sub>	ambient temperature		-65	+150	°C
T <sub>stg</sub>	storage temperature		-65	+150	°C

[1] Non-repetitive current pulse 8/20  $\mu$ s exponential decay waveform according to IEC 61000-4-5.



Table 6: ESD maximum ratings

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{ESD}$	electrostatic discharge voltage	IEC 61000-4-2 (contact discharge)	[1][2]		
PESD3V3U1UT			-	30	kV
PESD5V0U1UT			-	30	kV
PESD12VU1UT			-	30	kV
PESD15VU1UT			-	30	kV
PESD24VU1UT			-	23	kV
PESDxU1UT		HBM MIL-STD-883	-	10	kV

[1] Device stressed with ten non-repetitive ESD pulses.

[2] Measured from pin 1 to 2

Table 7: ESD standards compliance

Standard	Conditions
IEC 61000-4-2; level 4 (ESD)	> 15 kV (air); > 8 kV (contact)
HBM MIL-STD-883; class 3	> 4 kV

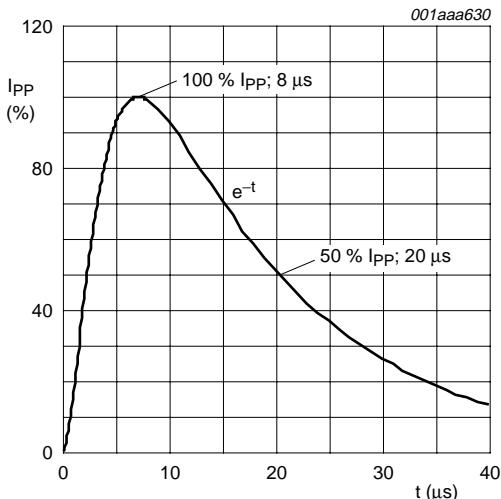


Fig 1. 8/20  $\mu$ s pulse waveform according to IEC 61000-4-5

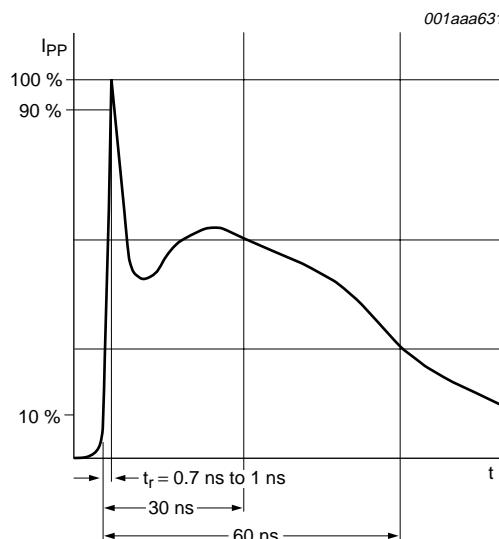


Fig 2. ESD pulse waveform according to IEC 61000-4-2

## 6. Characteristics

**Table 8: Characteristics** $T_{amb} = 25^\circ C$  unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{RWM}$	reverse stand-off voltage					
	PESD3V3U1UT		-	-	3.3	V
	PESD5V0U1UT		-	-	5.0	V
	PESD12VU1UT		-	-	12	V
	PESD15VU1UT		-	-	15	V
	PESD24VU1UT		-	-	24	V
$I_{RM}$	reverse leakage current					
	PESD3V3U1UT	$V_{RWM} = 3.3$ V	-	0.25	2	$\mu$ A
	PESD5V0U1UT	$V_{RWM} = 5.0$ V	-	0.03	1	$\mu$ A
	PESD12VU1UT	$V_{RWM} = 12$ V	-	< 1	50	nA
	PESD15VU1UT	$V_{RWM} = 15$ V	-	< 1	50	nA
	PESD24VU1UT	$V_{RWM} = 24$ V	-	< 1	50	nA
$V_{BR}$	breakdown voltage	$I_R = 5$ mA	[2]			
	PESD3V3U1UT		5.8	6.4	6.9	V
	PESD5V0U1UT		7.0	7.6	8.2	V
	PESD12VU1UT		14.2	15.0	16.7	V
	PESD15VU1UT		17.1	18.9	20.3	V
	PESD24VU1UT		25.4	27.8	30.3	V
$C_d$	diode capacitance	$f = 1$ MHz; $V_R = 0$ V	[2]		0.6	pF
$V_{CL}$	clamping voltage		[1] [2]			
	PESD3V3U1UT	$I_{PP} = 1$ A	[1]		-	9
		$I_{PP} = 5$ A	[2]		-	20
	PESD5V0U1UT	$I_{PP} = 1$ A	[1]		-	12
		$I_{PP} = 5$ A	[2]		-	21
	PESD12VU1UT	$I_{PP} = 1$ A	[1]		-	23
		$I_{PP} = 5$ A	[2]		-	39
	PESD15VU1UT	$I_{PP} = 1$ A	[1]		-	28
		$I_{PP} = 5$ A	[2]		-	53
	PESD24VU1UT	$I_{PP} = 1$ A	[1]		-	40
		$I_{PP} = 3$ A	[2]		-	76
$r_{dif}$	differential resistance	$I_R = 1$ mA				
	PESD3V3U1UT		-	-	400	$\Omega$
	PESD5V0U1UT		-	-	80	$\Omega$
	PESD12VU1UT		-	-	200	$\Omega$
	PESD15VU1UT		-	-	225	$\Omega$
	PESD24VU1UT		-	-	300	$\Omega$

[1] Non-repetitive current pulse 8/20  $\mu$ s exponential decay waveform according to IEC 61000-4-5.

[2] Measured from pin 1 to 2

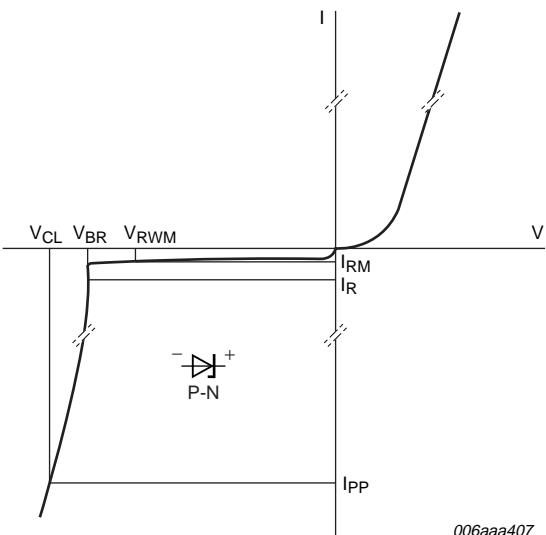
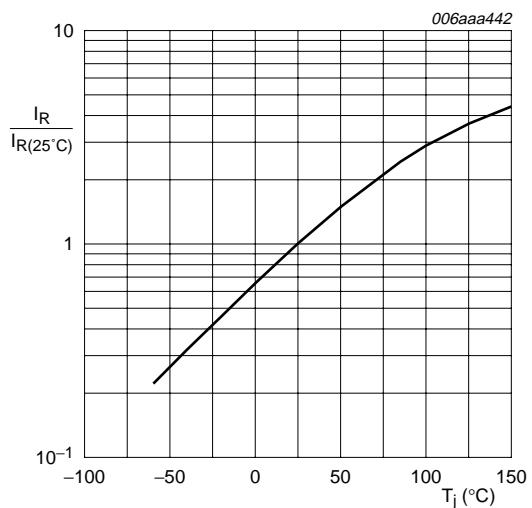


Fig 3. V-I characteristics

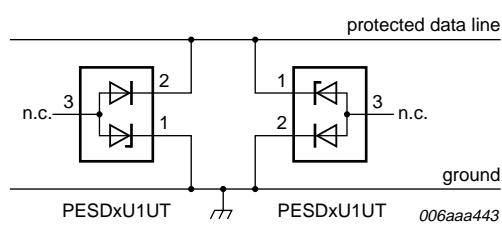


PESD3V3U1UT; PESD5V0U1UT  
 $I_R$  is less than 10 nA at 150 °C for:  
PESD12VU1UT; PESD15VU1UT; PESD24VU1UT

Fig 4. Relative variation of reverse leakage current as a function of junction temperature; typical values

## 7. Application information

The PESDxU1UT series is designed for protection of high-speed datalines from damage caused by ESD and surge pulses. PESDxU1UT devices combine an ESD protection diode and an ultra low capacitance compensation diode to ensure an effective device capacitance as low as 0.6 pF. The PESDxU1UT series provides a surge capability of up to 200 W per line for an 8/20  $\mu$ s waveform.



Two PESDxU1UT devices in anti-parallel configuration provide ESD protection in a common-mode application.

The two PESDxU1UT devices should be connected as follows:

**protected data line is connected to**

device 1 / pin 2

device 2 / pin 1

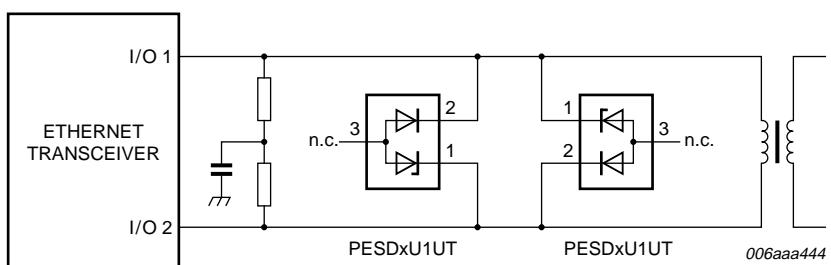
**Ground is connected to**

device 1 / pin 1

device 2 / pin 2

pin 3 is not connected for both devices

**Fig 5. Bi-directional ESD protection of one line, common mode**



Two PESDxU1UT devices in anti-parallel configuration provide ESD protection in a differential-mode configuration as e.g. for Ethernet applications.

The two PESDxU1UT should be connected as follows:

**I/O line 1 is connected to**

device 1 / pin 2

device 2 / pin 1

**I/O line 2 is connected to**

device 1 / pin 1

device 2 / pin 2

pin 3 is not connected for both devices

**Fig 6. Differential mode Ethernet protection**

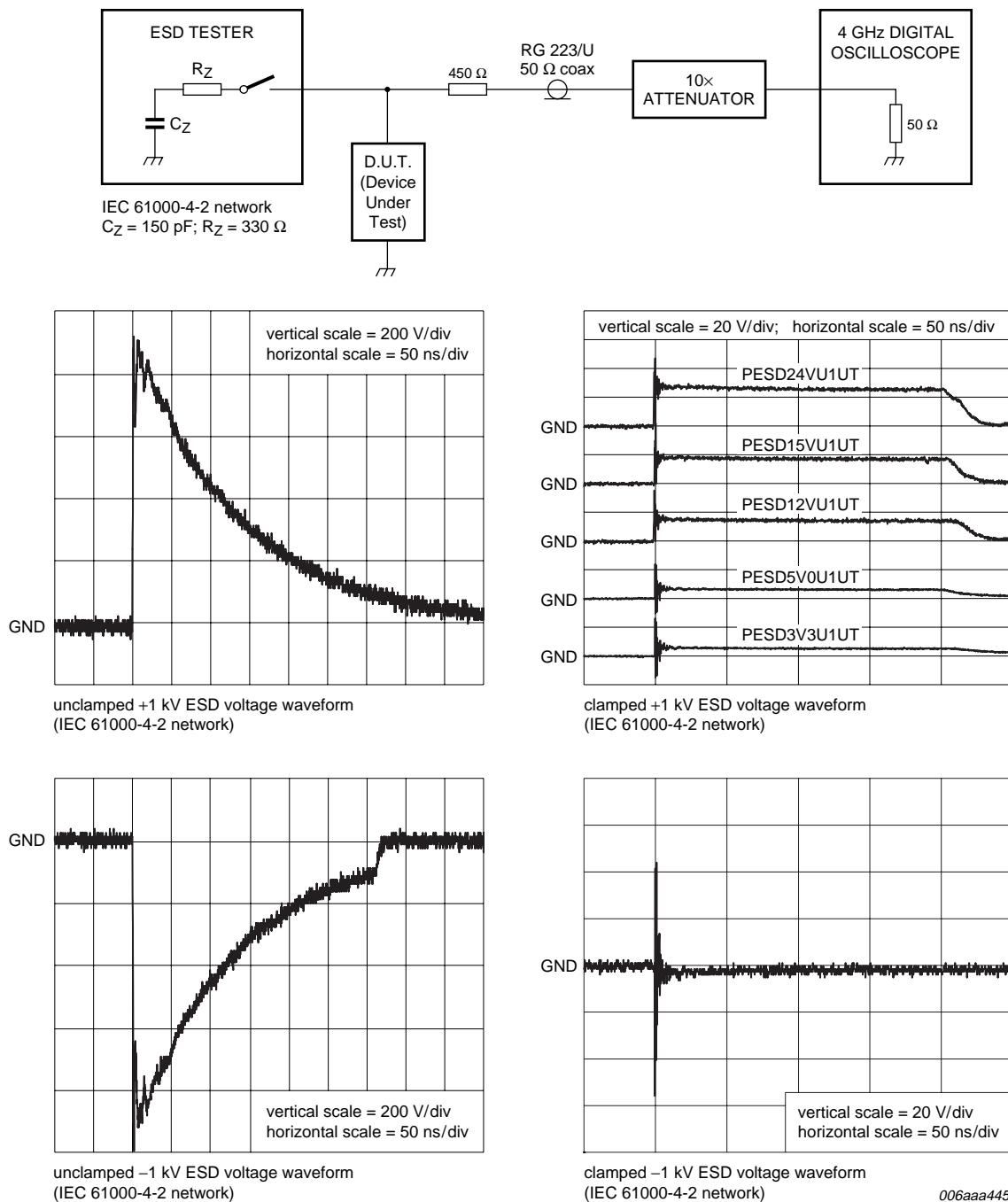


### Circuit board layout and protection device placement

Circuit board layout is critical for the suppression of ESD, Electrical Fast Transient (EFT) and surge transients. The following guidelines are recommended:

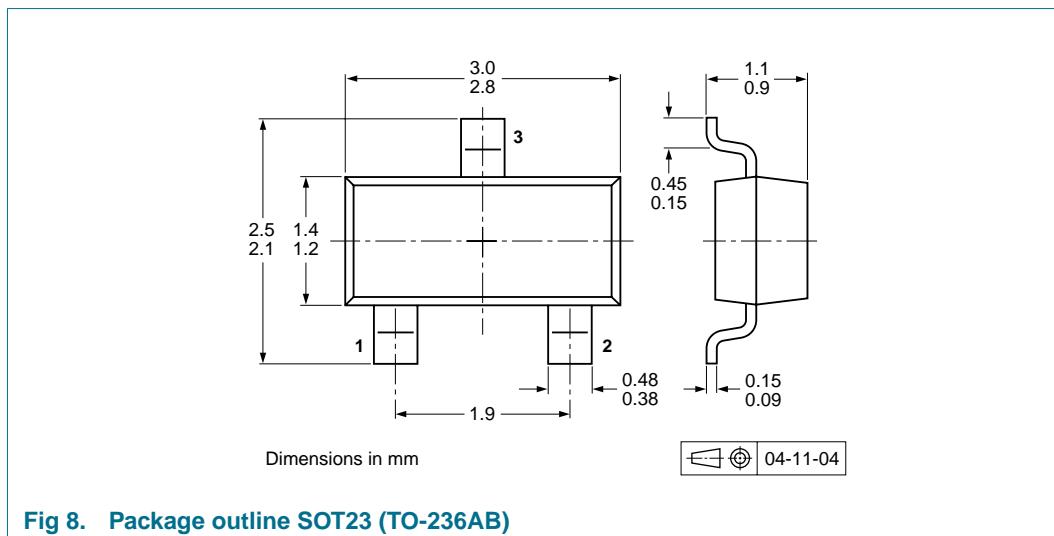
1. Place the PESDxU1UT as close to the input terminal or connector as possible.
2. The path length between the PESDxU1UT and the protected line should be minimized.
3. Keep parallel signal paths to a minimum.
4. Avoid running protected conductors in parallel with unprotected conductors.
5. Minimize all printed-circuit board conductive loops including power and ground loops.
6. Minimize the length of the transient return path to ground.
7. Avoid using shared transient return paths to a common ground point.
8. Ground planes should be used whenever possible. For multilayer printed-circuit boards, use ground vias.

## 8. Test information



**Fig 7. ESD clamping test set-up and waveforms**

## 9. Package outline



## 10. Packing information

**Table 9: Packing methods**

The -xxx numbers are the last three digits of the 12NC ordering code. [1]

Type number	Package	Description	Packing quantity	
			3000	10000
PESD3V3U1UT	SOT23	4 mm pitch, 8 mm tape and reel	-215	-235
PESD5V0U1UT				
PESD12VU1UT				
PESD15VU1UT				
PESD24VU1UT				

[1] For further information and the availability of packing methods, see [Section 16](#).



## 11. Revision history

Table 10: Revision history

Document ID	Release date	Data sheet status	Change notice	Doc. number	Supersedes
PESDXU1UT_SER_1	20050511	Product data sheet	-	9397 750 14912	-



## 12. Data sheet status

Level	Data sheet status <sup>[1]</sup>	Product status <sup>[2][3]</sup>	Definition
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
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**Short-form specification** — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

**Limiting values definition** — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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Date of release: 11 May 2005  
Document number: 9397 750 14912



Published in The Netherlands